

INVENTING TOMORROW

ALL IN THE FAMILY

Maroon and gold runs deep
in alumni families >>

ALSO INSIDE:

Students balance academics
with Big Ten sports >>

Faculty collaborate on research
in the Biotechnology Institute >>

INVENTING TOMORROW

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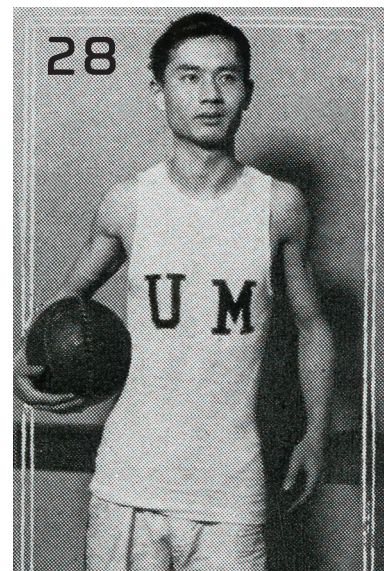
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winter 2014

INVENTING TOMORROW

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PHOTO BY RICHARD G. ANDERSON

STEVEN L. CROUCH



A tradition of excellence continues on campus today

WALKING ACROSS CAMPUS, it is quickly evident that students today are different from when I was a student at the University of Minnesota more than four decades ago. Their clothes are different, their music is different and, more than anything, the electronics they use are different.

However, what has remained consistent throughout the generations is students' commitment to excellence and their drive to make a difference in the world. This issue of *Inventing Tomorrow* shows how our College of Science and Engineering tradition of excellence continues today.

“What has remained consistent throughout the generations is students’ commitment to excellence and their drive to make a difference in the world.”

That legacy of success is evident in the cover story in this issue, “All in the Family,” that highlights two families with University of Minnesota College of Science and Engineering roots that run deep through several generations. Both families have several generations of family members who sampled a wide range of experiences during their engineering education at the U and discovered their entrepreneurial spirit after graduation.

In the story entitled “A Balancing Act,” we see how four CSE students are balancing their rigorous academics with being a part of Big Ten athletics. For these students, there’s no time for time-wasters, such as TV or Facebook. You can’t be a star athlete and a star student without dedication. These students represent a new generation of committed students who realize that sometimes sacrifices have to be made to achieve your dreams.



The University launches a new era of excellence with the Grand Opening of the new Physics and Nanotechnology Building. Join us for an Open House on Thursday, April 24, 11 a.m.-2 p.m. or 4-7 p.m. See the new building that includes about 40 new research laboratories and more than 15,000 square feet dedicated to nanotechnology research.

Another area where our legacy shines through today is in research. In “Collaborating for Results,” we focus on how CSE faculty are working together with other researchers in the University’s Biotechnology Institute (BTI) to find solutions to grand challenges such as clean water, carbon neutral biofuels, and bio-films used in medicine and environmental research. In the last three decades, the BTI has grown from a few faculty members to close to 30, representing 17 departments and seven colleges at the University. Results from this research will have a lasting impact for generations.

The College of Science and Engineering’s impact throughout the last century also reaches around the world. In our Retrospect story, we celebrate the 100th anniversary of the first Chinese students at the University—one who majored in chemistry and two more who majored in engineering. The courage of these first Chinese students became a cornerstone for today’s 80 academic and strategic partnerships with universities in China and has translated into 2,500 students and 500 scholars on the University of Minnesota’s campuses each year. Our students also see the value of a global education; about one in every three University of Minnesota students gains an international experience during their education.

This is an exciting time in the University of Minnesota College of Science and Engineering. We can look back with pride on more than a century of success and also look forward to meeting the challenges of the next century. We plan to do this by continuing to recruit the next generation of outstanding students and faculty. We also will continue working to provide the best facilities that meet future research needs. With support from our entire community, I am confident our legacy will continue for many more generations. ■

RECOMMENDED Extras

on the Web

To see these videos and more featuring College of Science and Engineering faculty, students, and alumni, visit our page on YouTube at www.youtube.com/umncse.

2013: A year to remember



It was a spectacular, victorious, groundbreaking 2013 for the University of Minnesota—on all of its campuses. Here are just a few of the inspiring highlights.

NOvA: Building a next generation neutrino experiment



Learn how collaboration between government research institutions like Fermilab, academia, and industry can create one of the largest neutrino detectors in the world.

Outdoor Stream Lab turns five



Jessica Kozarek, manager of the Outdoor StreamLab at the University's St. Anthony Falls Laboratory, shows off some surprising natural beauty that thrives in an artificial stream.

Annamaria Szabolcs: Innovation Fellows



Learn more about the Medical Devices Center's Innovation Fellows Program, which is a full immersion educational and product development program focused on creating medical devices.

Solving society's most important problems



Innovative research in the University's Department of Chemistry is aimed at solving some of society's most important problems related to new energy sources, human health, and the environment.

CSE Winter light show



A light show designed by CSE students has become a winter tradition on campus. The high-tech show features more than 100,000 LED lights synchronized to music, for a magical experience.

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FOLLOW US ON FACEBOOK AND TWITTER

More than 3,400 students, alumni, and friends have joined us on the College of Science and Engineering Facebook page at facebook.com/umn.cse. Also follow us on Twitter.com/umncse for the latest news about the college.

Inventing Tomorrow available online

To view an interactive online version of the current *Inventing Tomorrow* or to see past issues, visit our archives at: cse.umn.edu/inventingtomorrow.



U researchers discover new approach to improve personalized cancer treatments

RESEARCHERS from the University of Minnesota, Mayo Clinic, and University of Toronto, have shown that a new method for targeting mutated cells could create a major breakthrough in a personalized medicine approach to treat cancer. The findings were recently published in *Cancer Research*, a journal of the American Association of Cancer Research.

The research discovers susceptible genes in cancer cells using synthetic lethal interactions—pairs of genes in which mutation in either gene alone causes no damage to the cell, but where mutations in both cause the death of the cell.

“When we find these interactions in human cells, it could hold the key to effective, targeted cancer treatments,” said Chad Myers, lead researcher and associate professor of computer science and engineering. “Specifically, drugs could be used to target the synthetic lethal interaction partners of cancer-associated genetic mutations. These drugs would then effectively kill cancer cells but spare otherwise identical cells lacking the cancer-related genetic alteration.”

Myers and his collaborators used research on yeast genes to find synthetic lethality, and then found genes in humans that were similar in structure and evolutionary origin to the yeast cells. Myers worked with Dr. Dennis Wigle, a practicing thoracic surgical oncologist at Mayo Clinic, to test those interactions in human cells.

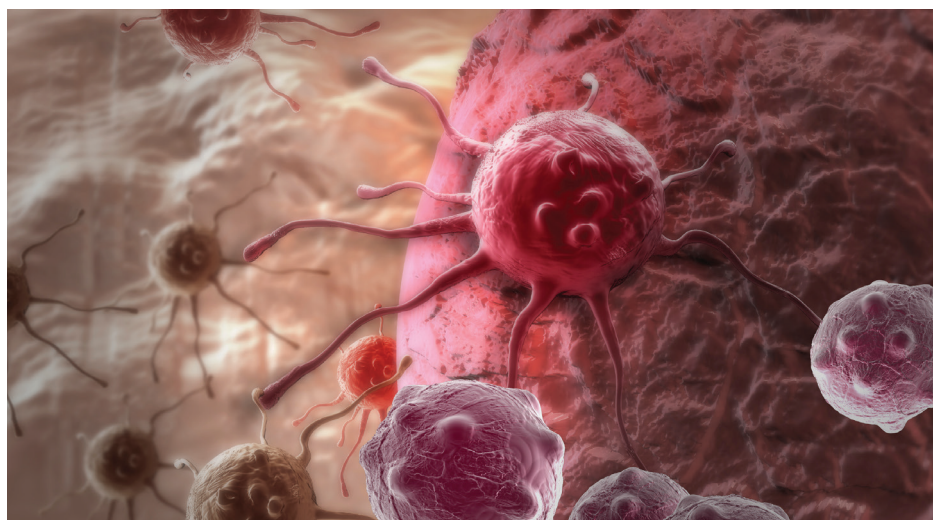
They found two striking cases where synthetic lethal interactions were similar between yeast and human cells. These interactions involve genes that are frequently mutated in specific types of cancer and provide potential new drug targets for these tumors.

“About 40 percent of yeast genes have homologs in humans. We thought that inferring interactions across species may provide a quick way of getting at these interactions,” Myers said.

“Given our expertise with the yeast interactions, we developed a strategy for narrowing down the large list of interactions to test, based on sequence similarity between the genes and public databases of genes commonly mutated in cancer as well as other features.”

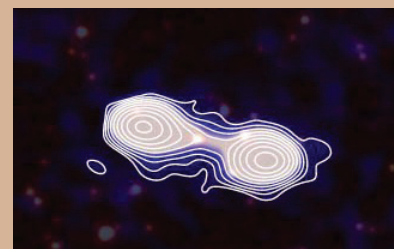
Decades of drug discovery research have produced a limited number of targeted therapies for treating cancer. The most commonly used therapies involve delivering high doses of radiation or toxic chemicals to the patient, which can help to suppress tumor growth but also cause substantial damage to normal tissue.

“The strategy of using synthetic lethal interactions to identify drug targets, particularly for ‘undruggable’ cancer genes is an attractive alternative method for drug target discovery,” Wigle said. “This technology is an important means to fully leverage information from sequencing projects for clinical application.”



University of Minnesota computer scientists are working with physicians to develop a new treatment that would kill cancer cells but spare healthy ones.

Radio Galaxy Zoo launches “citizen science” project



Can you see the infrared galaxy between its radio jets?

AN INTERNATIONAL TEAM of researchers, including University of Minnesota astronomers, has launched an innovative “citizen science” project called Radio Galaxy Zoo that allows anyone to become a cosmic explorer.

All you have to do is match images taken both in infrared and radio wavelengths—and this will give information on whether or not the galaxy has a supermassive black hole at its center. The infrared data comes from NASA’s Wide-Field Infrared Survey Explorer (WISE) satellite, while the radio data is from the Karl G. Jansky Very Large Array (VLA) in New Mexico—astronomers plan to include even more data in the future.

A black hole is an object for which gravity is so strong that even light cannot get out. Supermassive black holes drag in nearby material, growing to billions of times the mass of our sun and occasionally producing spectacular jets of material traveling nearly as fast as the speed of light. These jets often can’t be detected in visible light, but are seen using radio telescopes.

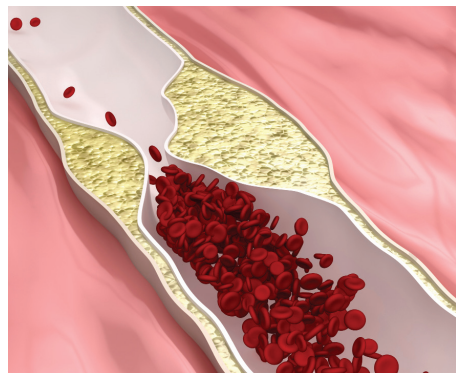
“Eventually, we will have up to 20 million radio sources that need classifications,” said Lawrence Rudnick, professor of physics and astronomy, who is involved with the project, along with Lucy Fortson, associate professor of physics and astronomy, and postdoc researcher Kyle Willett. “Computers and a few astronomers can take us only so far. Pattern recognition by large numbers of people will be essential in finding these black holes.”

To start your own classifications, visit radio.galaxyzoo.org.

U signs agreement that could help people with artery disease

THE UNIVERSITY OF MINNESOTA has signed a second license agreement with International Cardio Corporation (ICC), a privately-held Minnesota start-up company, that could help millions with artery disease.

Many cardiovascular diseases stem from atherosclerosis—a condition that develops when a



Atherosclerosis is a condition in which arteries become blocked due to plaque buildup on the artery walls. This leads to peripheral artery disease (PAD), which affects 8 to 12 million Americans.

substance called plaque builds up in artery walls. This buildup can restrict blood flow or detach from the artery wall to form blood clots. The build up often leads to peripheral artery disease (PAD), which affects 8 to 12 million Americans; 1 in 3 older Americans with diabetes have PAD.

The condition can be treated with drugs, or the patient can undergo an angioplasty—a procedure in which the arteries are inflated using a small balloon.

In 2011, the first license agreement between ICC and the University was signed for the innovative high-intensity focused ultrasound (HIFU) technology to treat atherosclerosis. The HIFU technology uses a thermal effect to ablate the plaques in blood vessel walls that restrict blood flow caused by the condition.

The technology was developed by a University team of researchers led by Emad Ebbini, professor of electrical and computer engineering.

Ebbini and his team now have further refined the technology by developing a dual-mode ultrasound array (DMUA) system that adds an image-

guided component to the treatment. The new approach makes it possible to image and treat the condition simultaneously, improving the safety and efficacy of the treatment.

“Existing treatments for PAD and related conditions, such as angioplasty or catheter use, can be risky and are not nearly as precise,” said Ebbini. “Our research has demonstrated that, with DMUA imaged guided HIFU, we can effectively treat the problem areas in a completely non-invasive way without damaging any of the surrounding, normal tissues.”

This success is a key indicator that the technology may work in other areas, such as to target specific nerves to manage chronic pain and hypertension, and has prompted ICC to explore this new field of use with the University.

“HIFU represents a paradigm shift in how we treat conditions that affect a large number of people around the world. And now we are well on our way to bringing this groundbreaking innovation to market,” said Dennis Sellke, Chief Executive Officer of International Cardio Corporation.

University is first to install ultrafast electron microscope

THE UNIVERSITY OF MINNESOTA—Twin Cities is the first in the world to install a new FEI Tecnai™ Femto ultrafast electron microscope (UEM). It will enable scientists to explore ultrafast events and processes that occur at the atomic and molecular spatial scale over time spans measured in femtoseconds (one millionth of a billionth of a second).

Researchers expect the technology will enable them to conduct fundamental research on the structure and dynamics of matter that could lead to new solutions in energy, medicine, and digital technologies.

Manufactured by FEI Company, the Tecnai™ Femto UEM is the first system to commercialize the patented ultrafast electron microscopy technology pioneered by Nobel laureate Professor Ahmed Zewail at the CalTech.

“Our new microscope will be used at incredibly small and fast scales, and it should have a big impact on our research,” said David Flannigan, an assistant professor of chemical engineering and materials science and a former member of Professor Zewail’s research team at Caltech. “Over the last decade microscope manufacturers like FEI have developed instruments that have made observations of objects as small as individual atoms seemingly routine. Ultrafast electron micros-

copy now gives us a powerful tool to look at the movements and changes that occur at this scale.”

The equipment is being installed this winter in the University of Minnesota Shepherd Laboratories and will be moved to its permanent location in the Gore Annex of Amundson Hall when construction is completed next year.



Researchers expect the Tecnai™ Femto ultrafast electron microscope will help them conduct research that will lead to new discoveries in energy, medicine, and digital technologies.

CSE by the numbers

FALL ENROLLMENT for the College of Science and Engineering shows that the college continues to attract the best and brightest students.

2012-13 2013-14

Total Enrollment

Undergraduates	5,098	5,150
Graduate students	2,656	2,638

Freshman class

Female students	273	283
* Average ACT score	30.6	30.8
** National Merit Scholars	73	78

Number of applications received

Undergraduate	9,987	11,552
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*This is the highest of any college at the University and the highest ever for the college.

**Of the University’s 136 freshman National Merit Scholars, this year 78 are from CSE, more than any other college at the University.

Breakthrough technique could potentially make electronics smaller and better

INTERNATIONAL RESEARCHERS from the University of Minnesota, Argonne National Laboratory, and Seoul National University have discovered a groundbreaking technique in manufacturing nanostructures that could potentially make electrical and optical devices smaller and better.

The research was recently published in *Nature Communications*, an international online scientific journal.

Combining several standard nanofabrication techniques—with the final key addition of Scotch Magic Tape—researchers at the University of Minnesota created extremely thin gaps through a layer of metal and patterned these tiny gaps over the entire surface of a 4-inch silicon wafer. The smallest gaps were only one nanometer wide, much smaller than most researchers have been able to achieve. In addition, the widths of the gaps could be controlled on the atomic level. This work provides the basis for producing new and better nanostructures that are at the core of advanced electronic and optical devices.

One potential use of nanometer-scale gaps in metal layers is to squeeze light into spaces much smaller than is otherwise possible. Collaborators at Seoul National University, led by Prof. Dai-Sik Kim, and Argonne National Laboratory, led by Dr. Matthew Pelton, showed that light could readily be squeezed through these gaps, even though the gaps are hundreds or even thousands of times smaller than the wavelength of the light used. Researchers are very interested in forcing light into small spaces because this is a way to boost the intensity of the light. The collaborators

found the intensity inside the gaps is increased by as much as 600 million times.

“Our technology, called atomic layer lithography, has the potential to create ultra-small sensors with increased sensitivity and also enable new and exciting experiments at the nanoscale like we’ve never been able to do before,” said Sang-Hyun Oh, University of Minnesota professor of electrical and computer engineering and one of the lead researchers. “This research also provides the basis for future studies to improve electronic and photonic devices.”

One of the most surprising outcomes of the research is that Scotch Magic Tape was one of the keys to the discovery. Etching one-nanometer-wide gaps into metals is not feasible with existing tools. Instead, the researchers in Oh’s team constructed the nano-gaps by layering atomic-scale thin films on the sides of metal patterns and then capping the structure with another metal layer. No expensive patterning tools were needed to form the gaps this way, but it was challenging to remove the excess metals on top and expose the tiny gaps. During a frustrating struggle of trying to find a way to remove the metal films, University of Minnesota Ph.D. student and lead author of the study Xiaoshu Chen found that by using simple Scotch Magic Tape, the excess metals could be easily removed.

“The Scotch tape works nicely, which was unexpected,” said Oh. “Our technique is so simple yet can create uniform and ultra-small gaps like we’ve never been able to do before. We hope that it will rapidly be taken up by many researchers.”

University launches medical device master’s program



ISTOCK PHOTO

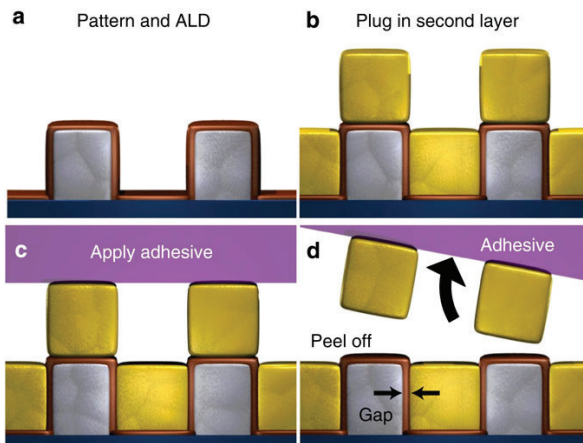
THE UNIVERSITY OF MINNESOTA’S Technological Leadership Institute (TLI) is recruiting students for its new master’s degree program in medical device innovation to begin in June.

The engineering-focused curriculum is designed to prepare students for careers in the medical device industry, which employs more than 250,000 people in Minnesota. Students will also be exposed to project and business management principles in addition to intellectual property and regulatory affairs.

The program will be headed up by Daniel L. Mooradian, who is the newly hired James J. Renier Chair in Technology Management and director of graduate studies for the new degree. Mooradian worked as a researcher and manager at Boston Scientific and Synovis Life Technologies, a maker of surgical tools and implantable biomaterials. He has also founded a number of medtech startups.

“The technical training students and early professionals generally receive—while necessary—is insufficient for success in the medical device industry,” said Mooradian. “This program is designed to provide students with the knowledge of industry, regulatory and global trends needed to give them a sustained competitive career advantage, and to give their companies enhanced capability for innovation and growth.”

For more information, visit the website at: mdi.umn.edu.



In a breakthrough study to improve the manufacturing process of optical and electronic devices, University of Minnesota researchers introduced a new patterning technology, atomic layer lithography, based on a layering technique at the atomic level. A layer of metal fills the nano-patterns over an entire wafer and simple Scotch Magic tape was used to remove the excess metal on the surface and expose the atomic scale nano-gaps.

University of Minnesota researchers harness the energy from New York City's East River

UNIVERSITY OF MINNESOTA researchers, led by Fotis Sotiropoulos, professor of civil engineering and director of the St. Anthony Falls Laboratory (SAFL), have launched a hydrokinetic research project in collaboration with tidal turbine developer Verdant Power.

The project will advance research, innovation, and training in marine and hydrokinetic technology, an emerging renewable energy that harnesses the power of rivers, tides, and waves.

Developed around the United States's first federally licensed installation of a commercial tidal power turbine system array—the Roosevelt Island Tidal Energy (RITE) project in New York City's East River, the effort combines SAFL's cutting-edge computational modelling and experimental techniques with the industry expertise and unique field facilities of RITE Project lead, Verdant Power, and the materials science and manufacturing strengths of Energetx Composites, Inc., based in Holland, Mich.

The project is funded by a two-year, \$600,000 grant from the National Science Foundation, through its Partnerships for Innovation: Building Innovation Capacity program.

The overall goal of the project is to promote the growing marine and hydrokinetic industry by enhancing the performance and resilience of the technologies used while ensuring environmental compatibility. In addition, the project aims to in-

crease the marine and hydrokinetic technology workforce by developing and piloting the technological and entrepreneurial curriculum in a four-year hydrology degree program at Salish Kootenai College, a tribal college located in Pablo, Mont.

"This project will enable St. Anthony Falls Laboratory research to help industry partners succeed in developing a very high-profile marine and hydrokinetic resource, one that will supply renewable electricity to New York City," Sotiropoulos said.

"This partnership strategically positions our St. Anthony Falls Lab to spearhead the development and growth of marine and hydrokinetic renewable energy technology to support the national goal of 80 percent of U.S. electricity produced from clean energy sources by 2035," he added.

The researchers are developing a high-performance computing simulation toolbox to provide industry partners with an in-depth understanding of how turbines perform in and interact with real-life aquatic environments. Combining high-resolution simulations of turbine interactions in complex flow environments and aquatic ecosystems with site-specific water flow, streambed and ecosystem data from the RITE Project installation, researchers are using massively parallel supercomputers to:

- design and test the next generation of marine and hydrokinetic turbine rotor blades for reliable and efficient operation; and
- optimize the layout of Verdant's pilot-scale 30-turbine, 1.05MW array at the East River site.

Outcomes from the project support the RITE Project pilot deployment and help to promote industry development, expand the U.S. renewable energy portfolio, and accelerate the deployment of marine and hydrokinetic technologies throughout the nation and world. The educational component of the project is anticipated to serve as a model for implementation in other communities to enhance educational opportunities and produce the next generation of professionals for the marine and hydrokinetic industry.

In addition to Sotiropoulos, other University faculty members on the project include civil engineering professors Michele Guala and Miki Hondzo; research associates Leonardo Chamorro, Ali Khosronejad, and Seokkoo Kang; senior research associate Chris Ellis; engineer Craig Hill; and several graduate and undergraduate students.



IMAGE COURTESY OF VERDANT POWER

Researchers are developing high-performance computing simulation tools that will help industry partners understand how turbines, like the one shown above, perform in real-life aquatic environments.

Max Donath to head transportation safety consortium for region

THE UNIVERSITY'S CENTER FOR TRANSPORTATION STUDIES (CTS) will lead a \$10.4 million regional University Transportation Center consortium focused on improving transportation safety.



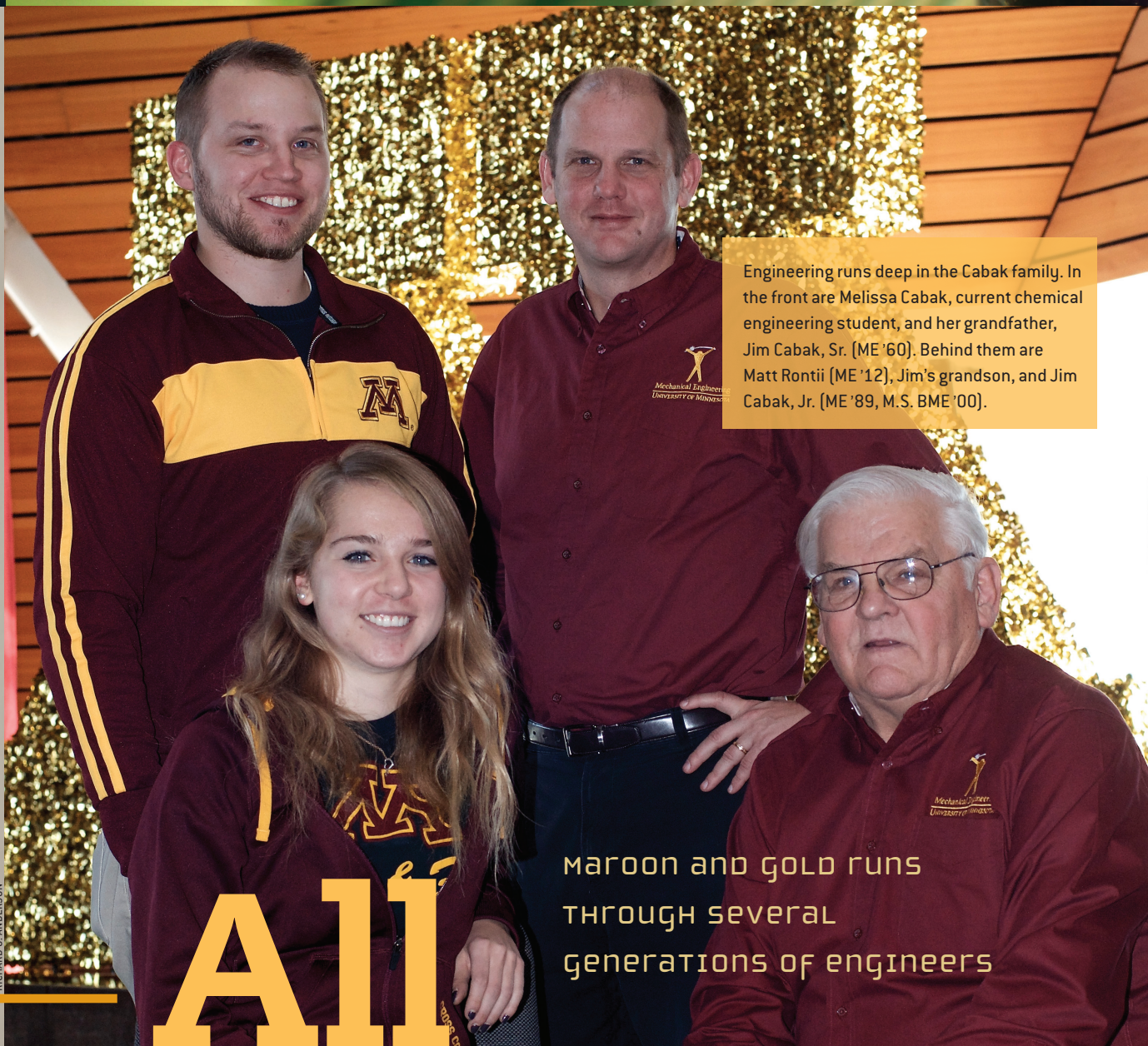
JAYME HALBRITTER

Max Donath, professor of mechanical engineering and an internationally recognized leader in transportation safety research, will serve as director of the new Region 5 Center for Roadway Safety Solutions, which includes Minnesota, Illinois, Indiana, Michigan, Ohio, and Wisconsin.

The two-year consortium will focus its research on regional issues related to high-risk road users and systematic safety improvements. Within these areas, the consortium will address multiple transportation modes across a variety of topic areas, including roadway departures, urban and rural intersections, pedestrians and bicyclists, and commercial vehicle drivers. The consortium will also explore transportation safety engagement in the region's Native American communities.

"This award allows us to bring together a multidisciplinary team of researchers from across the region to improve safety for broad groups of travelers," Donath said. "We've made great strides in transportation safety in the past 20 years, but that's not enough for the families and friends of the 4,500 people who died on our region's roads in 2011. We need to determine and deliver the next wave of transportation safety improvements."

Other members of the consortium are the University of Akron, University of Illinois at Urbana-Champaign, Southern Illinois University Edwardsville, and Western Michigan University.



Engineering runs deep in the Cabak family. In the front are Melissa Cabak, current chemical engineering student, and her grandfather, Jim Cabak, Sr. (ME '60). Behind them are Matt Rontii (ME '12), Jim's grandson, and Jim Cabak, Jr. (ME '89, M.S. BME '00).

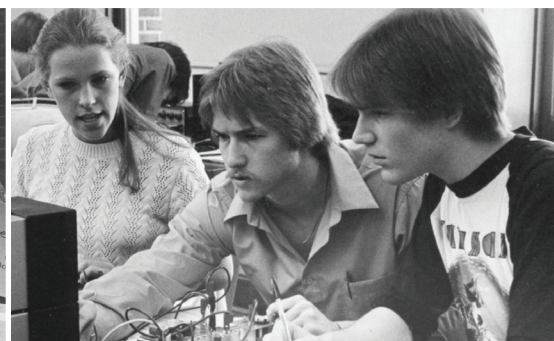
RICHARD G. ANDERSON

All

maroon and gold runs
through several
generations of engineers

in the FAMILY

WRITTEN BY GREG BREINING



Does engineering run in families? Travis Bather (ME '99) believes it might. He represents one of four consecutive generations of his family to graduate from the University of Minnesota College of Science and Engineering.

"I grew up liking to tinker with things and build things, so it was a fairly logical path," he said. "I think the other part of it—and I think this is where my family lineage comes into play—is we're a very practical people. I think our spouses would say painfully practical. It's very conducive to the engineering world."

Profiled below are two families with roots that run deep into the engineering fields. In most cases, the early influence of family steered them to the University and to engineering. Their stories illustrate not only the enduring value of a science and engineering degree—but also the importance of sampling a wide range of experiences early on, of discovering and feeding your entrepreneurial side, and finding inspiration, knowledge, and help from others—even if they may be part of your family.

The Cabak Family



James Cabak, Sr. in 1960

1960 GOPHER YEARBOOK

Jim Cabak, Sr., (ME '60) was about 12 when his older brother Michael enrolled in engineering at the University of Minnesota. "My brother's pretty smart," he remembers. He wondered, "I don't know why he wants to drive a train."

Soon enough, he learned about engineering. Growing up on a farm near Hinckley, Minn., Ca-

bak had many opportunities to exercise his mechanical aptitude. He enrolled in engineering in 1955. But his big dream, as a high school football player, was to try out for the University of Minnesota Gopher football team. "I walked on for about two days. I found out right away that it wasn't the place for me," Cabak said. "Too big? Too fast? All of the above."

So, he buckled down to studying mechanical engineering and struggled, as many engineering majors do to this day, with math and science. He took advantage of the co-op program (when the University operated on quarters and engineering took five years). Interning at Ford Motor Company in Detroit, he was shown a room the size of a football field filled with engineers at drafting tables. "I learned a lot at Ford," he said. "The main thing I learned is that I really didn't want to be a drawing board engineer. I figured I'd get lost out there."

After graduation, Cabak took two quarters of University business classes. He says it was a reaction to Ford. "You've got to know more than engineering unless you want to live on that farm the rest of your life," he said.

He went to work for General Mills, setting up packaging lines. After five years, he decided to try sales, where he thought he saw more opportunity. But he didn't want to sell Cheerios. So he moved to Chicago to work for a company that built packaging machinery. After five years, he moved to another company, selling processing equipment. There he learned about injectable thermosetting plastics. "I thought I could do that without too much trouble," he said.

As it was, his neighbor worked in an industry that used the material, and the two men formed a business to make molded plastic products. That was the beginning of Bulk Molding Compounds, Inc., a company Cabak would grow to about 75 employees and nearly \$20 million in annual sales before selling it in 1989. Since then, he has been involved in other small companies, investing or serving on boards.

Cabak says his engineering degree helped him to understand systems. "Aside from the details of engineering, it gave me the ability to understand an entire manufacturing or processing operation," he said. "It certainly was very helpful to me when I started BMC."



PATRICK O'LEARY

Except for the student fashions, the University of Minnesota mall area on the East Bank campus doesn't look much different today than from this photo at right, which was taken in 1946 when Ed Bather, Jr. was a student.



UNIVERSITY OF MINNESOTA ARCHIVES

“I feel CSE did a great job of preparing me for working in industry.”

—MATT RONTTI

At the same time, the two quarters of business coursework broadened his perspective. “It provided me with an understanding of accounting and what you have to do to make a project successful. The old cliché of you build a better product and the world will beat a path to your door really isn’t true. You’ve got to know how to market it. Most people don’t come looking for a product. You’ve got to bring it to them,” he said.

Jim Jr. follows father’s footsteps

For Jim Cabak’s son, Jim Jr., the fact that his dad was an engineer “helped a lot.” He followed in his father’s footsteps, enrolling in the University’s mechanical engineering program. Beside the family tradition of maroon and gold, the University offered more than smaller schools. “That’s the advantage of a big university—the big schools have the resources or access to whatever you need,” he said. He received his degree in 1989 and went to work for American Medical Systems, a company that made implants for incontinence and impotence. Cabak was fascinated by engineering solutions to medical problems. “It was fun to actually apply the skills you learned.”

But he wanted to learn more, especially on the medical side. He decided to pursue a master’s in biomedical engineering. “The biomed was so different from the mechanical,” said Cabak. “I really enjoyed that.”

Cabak took a chance and left for Boston Scientific, and then Medtronic. Finally, he went to Uromedica, a small company in Plymouth, Minn. founded by former American Medical Systems employees. The company sells devices for urinary incontinence but



Matt Rontti (ME '12) and his wife, Anna, stay connected to the University of Minnesota with Gopher athletic events.

PHOTO PROVIDED BY MATT RONTTI

only in Europe as it awaits FDA approval to sell in the United States. Cabak is the director of research and development and operations. “Since we’re small, I have to do it all,” he said. “One of the things I’ve learned is at a big company you can do a lot in a small area. In a small company, you get to do a lot of everything.”

Like grandfather and uncle

Matt Rontti (ME '12)—Jim Cabak, Sr.’s grandson and Jim Cabak Jr.’s nephew—credits his grandfather for sparking his interest in engineering. “Mathematics was always my strongest subject in high school, followed by the sciences,” said Rontti. “However, I remember visiting the mechanical engineering building and labs on the Minneapolis campus with my grandfather when I was young. I think that may have influenced my decision to attend the University of Minnesota because it was the only college I applied to. I never looked elsewhere.”

He also was drawn to the urban atmosphere, after growing up in Elk River, Minn. “I liked being close to the city, where major attractions were so convenient,” he said.

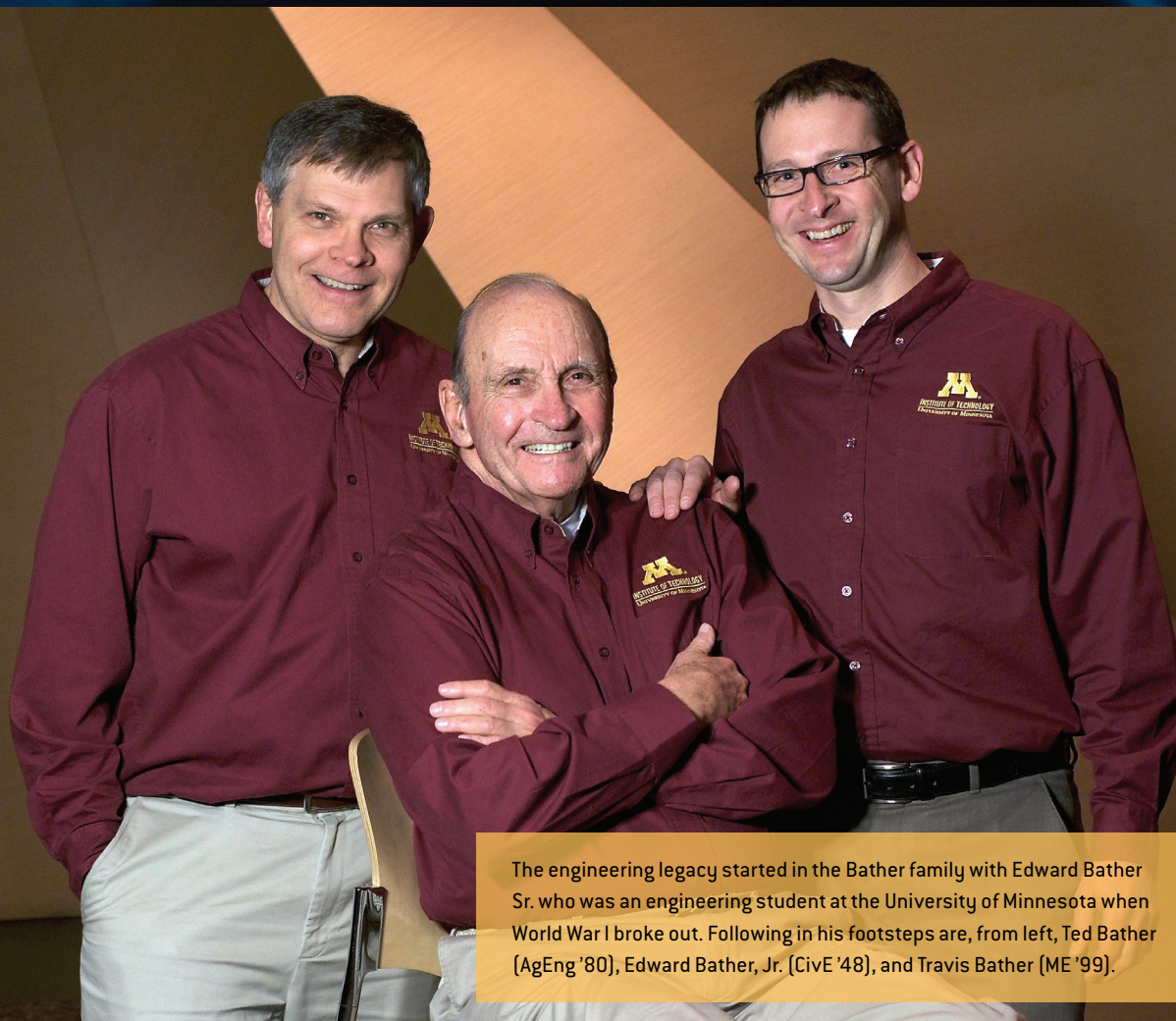
Like his grandfather and uncle before him, Rontti majored in mechanical engineering, which was his first choice. “It seemed like a natural and logical fit,” Rontti said.

As a student, Rontti participated in the Engineering Co-op Program at PaR Systems, Inc. in Shoreview, Minn. where he is now employed full-time as a mechanical engineer. Similar to an internship, the co-op experience provides valuable work experience during the last two years of a student’s



Not only does Melissa Cabak, a CSE student majoring in chemical engineering, regularly appear on the CSE Dean’s list (GPA of at least 3.66), she also participates in Big Ten sports as a member of the University’s women’s cross-country and track and field teams.

CHRIS MITCHELL



“I think the other part of it—and I think this is where my family lineage comes into play—is we’re a very practical people.”

—TRAVIS BATHER

The engineering legacy started in the Bather family with Edward Bather Sr. who was an engineering student at the University of Minnesota when World War I broke out. Following in his footsteps are, from left, Ted Bather (AgEng '80), Edward Bather, Jr. (CivE '48), and Travis Bather (ME '99).

RICHARD G. ANDERSON

academic career, and gives them an opportunity to apply some of their knowledge of fundamental theory to practical problem solving. Students also earn credits toward their degree program.

Rontti says he enjoys his position where he works on 3D CAD (computer-aided design) modeling for large-scale robotic applications. He is also looking into earning an advanced degree, perhaps an MBA or Management of Technology degree through CSE.

“I feel CSE did a great job of preparing me for working in industry,” Rontti said. “I would recommend it to any one of my friends or future family members.”

The next generation

Continuing the family’s engineering tradition is Melissa Cabak, Jim Jr.’s daughter. A sophomore in chemical engineering, she also competes for the University in women’s cross-country and track and field. She attributes her interest in engineering at least in part to watching her dad. “Because my dad works at a small company, I’ve been able to go in and see exactly what he does at a level I wouldn’t be able to do if he worked in a large company,” she said.

She likes science but is drawn to engineering for

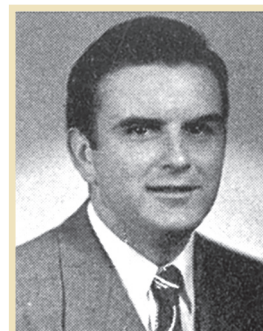
its practicality. “I have always been pretty good at math and science, but the appeal of engineering rather than a straight up chemistry degree is probably that I enjoy the application,” she said. “I’d rather have the whole knowledge base and get to go ahead and apply what I learned.”

The Bather Family

Like his father before him, Edward Bather, Jr. (CivE '48) started his education at the University in civil engineering, was called into the military, and then returned to finish his degree.


In the case of Edward Sr., he was in the midst of an engineering program when World War I interrupted his education. Ed Jr. started in 1942, was drafted in 1943 to serve on a ship in the Philippines during World War II, and returned to graduate in 1948.

Bather says his father clearly influenced his career choice. “I got to ride on a survey crew when I was a little guy. That was fun and good,” he said. And like his dad, after graduation he went to work



Ed Bather, Jr. in 1948

1948 GOPHER YEARBOOK



for the Minnesota Highway Department (now the Department of Transportation). But that's where the similarity ended. After one summer and fall on a survey crew, he decided he didn't like working for government.

So he switched sides. He went to work for the construction contractor Johnson, Drake & Piper, Inc., where he worked on highway construction in Florida, upstate New York, and New York City. For a kid from the Midwest, Bather said that New York City is kind of like the service. "You're glad you're in it, but you're glad you're over it," he said. He asked to move and got assigned to the Twin Cities.

Then his career took a turn. He began selling construction equipment for Ziegler Co., figuring his technical background was an advantage. "I think it helped just being able to relate to clients," Bather said. The move to sales provided a new perspective. "Being a salesman—I recommend it for just about any young guy to be able to knock on doors and have that kind of experience of a client relationship," he added.

Meanwhile, his dad formed his own construction-consulting firm just as the federal interstate system was being designed and built. "I felt he was in a position where he could afford me," said Bather, who soon realized an important aspect of transportation was underserved in Minnesota—traffic engineering. Bather hired a graduate of Yale's new traffic engineering program as well as another young engineer and formed BRW.

The firm grew to become a multi-discipline firm of about 100 people. Bather attributes its success to "being smart enough to hire people that are smarter than me. You've got to be able to do that. It's where you get success—by having smart people." Bather sold the business in 1974 and since has managed commercial space in the Edina, Minn. building the firm once owned.

Bather says an engineering degree is just as valuable as it was when he earned his. "I think it's always been a great profession to work in if you have the inspiration to do it," Bather said. "The number one thing you say about engineers is they're problem solvers. That's what you've got to have an interest in doing—solving problems."

“The number one thing about engineers is they’re problem solvers. That’s what you’ve got to have an interest in doing—solving problems.”

—EDWARD BATHER, JR.

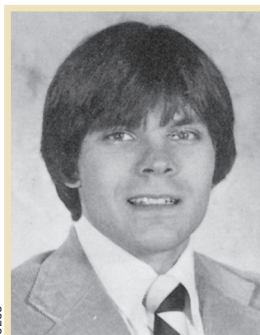


PATRICK O'LEARY

To help upcoming problem-solving engineers, Bather and his family founded the Bather Family Scholarship about 15 years ago, which pays all tuition to CSE for selected applicants. "These are students who have 4.0 GPAs," said Bather. "You can't find a B on their record."

Staying on the engineering track

"It was a natural thing to go to the University of Minnesota," said Edward Bather's son, Ted. "I was strongly influenced by the fact that my family has quite a history there," he said. And engineering was a natural choice too, because "I grew up in that culture."

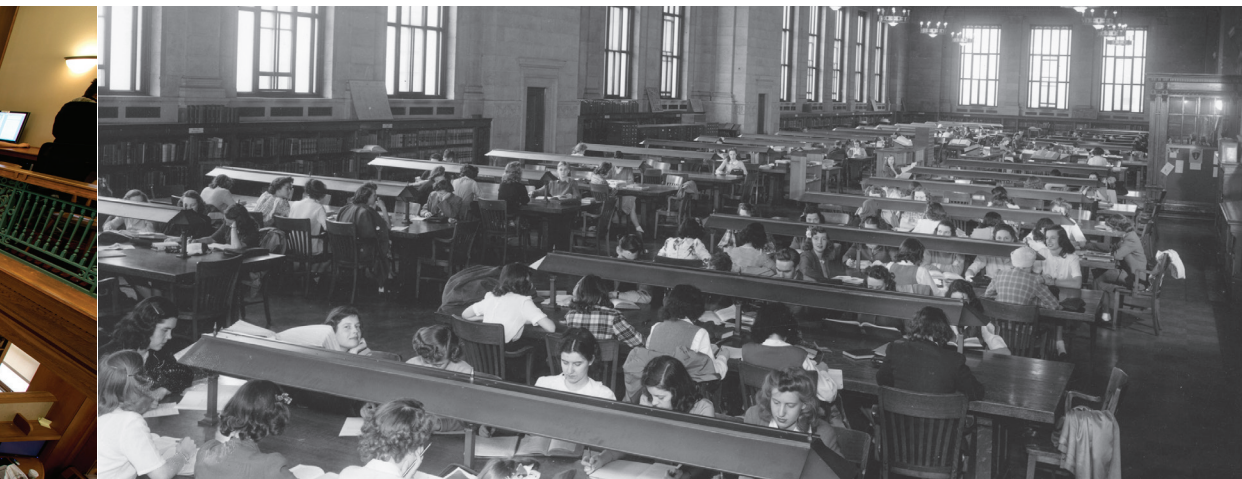


1980 TECHNOLOG

Ted Bather in 1980

Throughout his teens, Ted Bather (AgEng '80) worked for his dad on survey crews, counted cars, and laid out traffic counters. He also enjoyed working on two family hobby farms. So when it came time, he enrolled at the University in agricultural engineering.

After graduation, he joined Cargill and managed soybean-processing plants in Des Moines, Iowa and Lafayette, Ind. He left Cargill to return to Minnesota—"tough decision, one of the toughest of my life"—and joined an engineering consulting firm that worked with Cargill. Through acquisitions, the firm became London-based AMEC, where Bather is now global account leader for Cargill projects, and manager of projects for AMEC's Minneapolis office.



(Left) The Taylor Center in Lind Hall provides a high-tech study environment for College of Science and Engineering students today. (Right) University of Minnesota students study in Walter Library during the 1940s.

UNIVERSITY OF MINNESOTA ARCHIVES

An engineering degree provides many benefits, just as it did when he earned his in 1980, says Bather—good employment opportunities and high pay. But an engineering career also provides a chance to respond to the “insatiable curiosity” many engineers have.

“An engineering career can be tremendously valuable for satisfying that hunger because there are endless opportunities of challenges and problems to be able to tackle,” Bather said. Most engineers want to know “how things work and how you can make things better. That’s really what engineering is all about,” he said.

One more Gopher in the family

Travis Bather (ME '99)—Edward’s grandson and Ted’s nephew—was looking for a reason not to at-

tend the University of Minnesota because so many of his family had. (His father graduated from the University’s Carlson School of Management.) He says the weather tipped his decision toward Minnesota. The day he toured the University of Wisconsin–Madison campus, it was cold, windy, and rainy.

As a student Travis Bather interned at the same engineering consulting firm where his uncle worked. He joined the firm and is now the mechanical and piping department manager for AMEC, managing a group of engineers and design technicians.

Like virtually all engineers, Travis Bather recommends that engineers-to-be should have rock-solid math and science skills. “Beyond that, do what you love to do and focus on doing it well. Try to gather as much practical and hands-on experience as you can. Never stop trying to learn and grow,” he said. ■



A recognizable campus landmark, Washington Avenue’s original pedestrian bridge was built in 1940. In 2002, it was replaced by one covered in durable stainless steel and equipped with a snow and ice removal system.





CSE STUDENTS BALANCE
rigorous academics
WITH BIG TEN ATHLETICS

WRITTEN BY KERMIT PATTISON
PHOTOS BY JAYME HALBRITTER

A Balancing ACT

Katie Thyken, a mechanical engineering student, was named to the National Soccer Coaches Association of American Scholar All-American Third Team. Co-captain for the Gophers this season, she led the team with seven goals and three assists. Thyken is one of five Big Ten players named Scholar All-Americans.

Looking at Katie Thyken’s schedule during a one-week period this past fall, you might question how she did it all. The College of Science and Engineering student juggled a demanding academic schedule of 16 classes and labs in thermodynamics, design and manufacturing, electrical circuits, and biology. It was a heavy workload—and she had to finish it all by midweek.

On Wednesday night of that week, Thyken—co-captain of the Minnesota Gophers women’s soccer team—boarded a bus with her teammates and missed two days of classes. First stop: Madison, where her team won a dramatic victory against Wisconsin in the final minutes of double overtime. Next stop: Purdue, where Thyken scored two goals and earned herself honors as Big 10 offensive player of the week.

“It’s challenging to be a full-time student-athlete, period,” she said. “Add to that the challenge of a major that oftentimes demands more hours—not only class hours—but many of the majors within the College of Science and Engineering demand additional labs, discussion sections, and work groups.”

“They’re putting more time in the classroom which obviously takes away from something else,” Holleran added. “Many CSE kids have less free time.”

Katie Thyken: Shooting for the Goal

Katie Thyken doesn’t waste opportunities—whether for shots on goal or putting a spare 10 minutes to good use by opening up a textbook.

The junior majoring in mechanical engineering is considering a career in medical devices.

“I always say my dream job would be to make a Luke Skywalker mechanical hand,” she said.

Her 16-credit academic load requires 30-40 hours of study per week—on top of the 25 hours she devotes to soccer during the fall season.

Thyken grew up in Eden Prairie, Minn., and often watched Gophers soccer. She was recruited after University of Minnesota coaches saw her at a soccer camp.

She has learned the discipline of time management by watching her father, an information technology executive with a demanding job but who always carved out time to coach her soccer teams and attend games. “He taught me if you have little chunks of time, do something productive,” she said. “Don’t just laze around.”

Those chunks of time add up. A spare 20 minutes? Thyken will read a few pages of textbook, flip through

Not bad for a student who maintains a 3.9 GPA.

Thyken is one of a handful of students in the College of Science and Engineering who compete in Division I sports for the University of Minnesota. In this story, we meet four student-athletes who juggle the equivalent of two demanding full-time jobs.

About 750 student-athletes participate in University sports teams. According to Lynn Holleran, director of the McNamara Academic Center for Student-Athletes, only 8 percent of those athletes are enrolled in the College of Science and Engineering.





Justine Cherwink, a senior in chemical engineering, competed in five meets last season and saw her career-best score on uneven bars, balance beam, and floor exercise against Michigan State. She was also named to the Academic All-Big Ten team.



class notes or drop into a professor's office hours.

"It's definitely a lot of running from place to place and not having down time," she said. "At the same time, I'm most productive when I don't have free time, and I just have to get stuff done."

She doesn't go out often, either because she doesn't have time or because she is too tired after soccer. She doesn't watch much television and doesn't have time to participate in academic clubs.

Thyken spends about 25 hours per week on soccer. This includes two hours of daily practice and two games per weekend. Away games require a full weekend of travel by bus or plane. It's a year-round commitment that includes the fall competitive season plus training in spring, winter, and summer breaks.

Luckily, an athletic team provides a built-in social life. "I'm closer with all of these girls than most of the people I've met in school," said Thyken. "You spend so much time with them and travel with them. They become family. It's cool because you have 23 of your best friends that you get to see every day."

Justine Cherwink: Balancing Books and Beams

Justine Cherwink is a gymnast who knows how to balance.

This goes far beyond tumbling on the floor or flipping across a balance beam. The CSE senior from Aledo, Texas manages the workload of a chemical engineering major with the regimen of a Division I gymnast. She's also minoring in business management.

"Starting my freshman year, when I realized school was going to be pretty intense in chemical

engineering, I banned myself from any sort of social media or any of those silly, time-consuming things," said Cherwink. "It mainly comes down to prioritizing. I look at my assignments and things to do, rank them in urgency, and work on them in that order until I get them done."

She does get a lot done. Cherwink trains 30 hours per week, including coached practice in the gym, rehab, and supplemental training such as lifting weights. In season, she competes every week. Half of those competitions involve travel.

A petite 5-feet (the shortest one on the team), Cherwink has soldiered on despite two serious injuries. In her freshman year at Minnesota, she tore her left Achilles tendon and had surgery to repair it. "I asked the surgeon if I could stay awake and he let me watch it," she recalls. "I just got a spinal tap. I saw him sew the two pieces back together. I was interested in med school for a little bit."

The next year she tore the other Achilles tendon and had surgery again. Within four months she was competing on parallel bars again. One month after that, she was competing vault as well. Since then she has remained free of injury—although that requires many hours in the training room and constantly managing little aches and preventing them from turning into bigger problems.

Schoolwork consumes her remaining time. She often sleeps only six hours—and sometimes half of that when under the deadline of a school project. Much of her day is spent in two locations: Peik Gym and the Department of Chemical Engineering and Materials Science in Amundson Hall.

“It mainly comes down to prioritizing. I look at my assignments and things to do, rank them in urgency, and work on them in that order until I get them done.”

—JUSTINE CHERWINK

“We have a ChemE lounge that’s open 24 hours per day,” she said. “We spend nights working on lab reports there. It has a couch, microwaves, and everything you need for an all-nighter.”

Her social life is limited to her teammates and fellow chemical engineering students. She doesn’t dabble in social media. She loves to play ultimate Frisbee and read but doesn’t get the chance to do much of either. “It’s all-consuming,” she said.

Even so, Cherwink also has learned that life can’t be all work and no play. She makes sure to pepper her schedule with occasional fun events like meeting a friend for coffee or the even the occasional game of Frisbee.

Her advice? “Make sure you save a little time for a few things you like to do, just so you have those to look forward to,” she said. “You can’t go nonstop. I’ve tried, and broken down.”

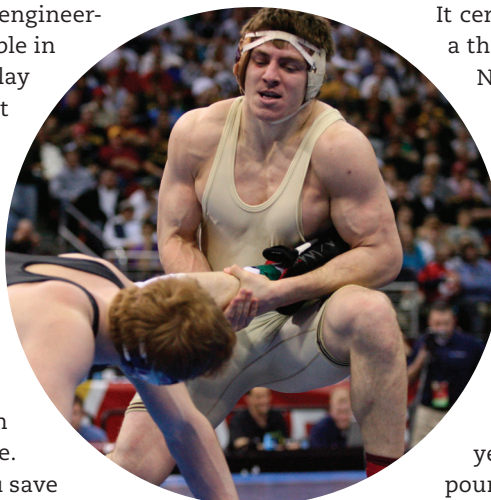
Tony Nelson: Carrying a Heavy Load

Tony Nelson is a heavyweight wrestler who can bench press 320 pounds.

His schedule demands some heavy lifting too. A two-time NCAA champion and Olympic hopeful, the CSE senior also shoulders the rigorous workload of a mechanical engineering major.

Nelson grew up in Cambridge, Minn., and won the high school state championship title in his senior year. Upon arriving at the University of Minnesota, he devoted himself to a program with a storied tradition. Under head wrestling coach J.P. Robinson, Minnesota has won three NCAA team championships, 14 individual titles, and produced 61 All-Americans over the last three decades.

“The program has the ability to transform guys into the top level of collegiate athletes,” said Nelson. “If you buy into what the coaches want you to do, you have a chance to become good. It’s worked for a lot of people.”



It certainly worked for Nelson. He is a three-time All-American and won NCAA heavyweight titles in 2012 and 2013 and has a chance to become Minnesota’s first-ever three-time national champion wrestler.

That requires a lot of work. Nelson devotes up to 20 hours per week to athletics, including practice in the wrestling room plus supplemental training such as lifting weights and running. In the last year, he bulked up from 245 to 270 pounds—mostly lean muscle.

Such discipline has rubbed off on his studies. In a typical week, Nelson spends up to 30 hours on academics. During the season, every weekend brings dual meets or tournaments. Often this requires travel and missing a day or two of classes. He has learned to get his work done ahead of time.

“I sacrifice spending time with friends,” he said. “For me, it’s being disciplined.”

Nelson will graduate this spring but won’t put his degree to use right away. First, he plans to pursue a more pressing opportunity—the 2016 Summer Olympics.

He plans to devote himself to full-time training in hopes of making the U.S. Olympic team in freestyle wrestling and likely will split time between the Twin Cities and the Olympic Training Center in Colorado Springs, Colo.

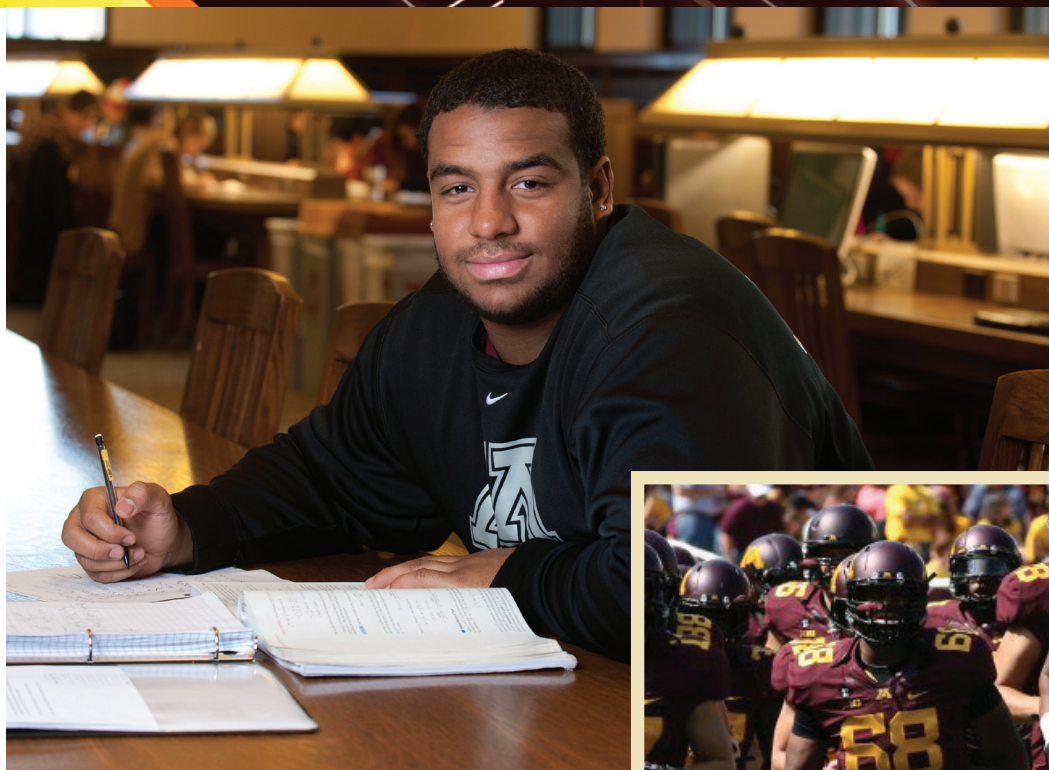
“Wrestling is a sport you wouldn’t do if you didn’t love it or enjoy it,” said Nelson. “It shows you how to work hard. Mechanical engineering is a tough major, but I’ve learned from wrestling how to put that extra time in and learned to figure out how things work and how to do things. That has helped me succeed.”

Two-time defending NCAA heavyweight wrestling champion Tony Nelson could earn a third straight national title this season. The CSE senior studying mechanical engineering would make history. It’s a feat never before accomplished at the University of Minnesota.



“Mechanical engineering is a tough major, but I’ve learned from wrestling how to put that extra time in and learned to figure out how things work and how to do things. That has helped me succeed.”

—TONY NELSON



Isaac Hayes was recruited by University of Minnesota coach Jerry Kill to the Golden Gopher football program as a member of the 2012 recruiting class. Although the CSE sophomore, who is studying mechanical engineering, redshirted his freshman year and didn't see much game time this past season, he puts in a full schedule with games, practices, and school work.

Isaac Hayes: Tackling a Tough Schedule

Sometimes Isaac Hayes glances at his Twitter feed and sees friends complaining about being bored. He can only roll his eyes.

Idleness is the least of his worries. His challenge is time. Hayes, who is majoring in mechanical engineering, also plays right guard on the Minnesota Gophers football team—and those responsibilities keep him booked from morning until bedtime.

“You really don’t have free time,” he said. “If you’re tired, you don’t have time to take a nap. You don’t have time to get nine hours of sleep at night. A lot of non-student athletes have free time during the day. I just don’t have that luxury.”

Hayes looks like an offensive lineman, which is to say he’s built like a refrigerator. He stands 6-foot-2 and weighs more than 300 pounds. He was a star player at St. Thomas Academy in Mendota Heights, Minn., where he was ranked as the ninth offensive guard nationwide by ESPN. He grew up watching Gophers football and chose the University of Minnesota because of his affection for his hometown team and rapport with football coach Jerry Kill.

Hayes devotes 20 hours per week to football. His commitment extends well beyond practice time on the field. It also includes three weightlifting sessions per week plus many hours reviewing game films and team meetings.

He gets home at 7:30 p.m. and spends his evenings studying. This past fall, he labored over calculus, in addition to building circuits and designing a robot that will shoot disks for his mechanical engineering class. He takes advantage of academic tutors at the

McNamara Academic Center for Student-Athletes.

A second year student (he redshirted his first year and remains a freshman in terms of athletic eligibility), he spends up to 25 hours per week on academics.

“I’ve had an interest in engineering all my life,” he said. “I like building things and understanding the mechanics. When I was little, I used to take things apart like my toys just to see how they worked.”

Time management is a familiar challenge. In high school, Hayes commuted 45 minutes each way from his home in Brooklyn Park, Minn. to St. Thomas Academy and often wouldn’t get home until 6:30 p.m. He learned that time management, like a good offense, requires strategic planning. He writes everything in his planner and prioritizes work accordingly.

“Sometimes I’ll see people on Twitter saying, they’re going home to chill or watch movies and stuff like that,” he said. “I’m sitting there saying, ‘I’m going to go home to do four hours of homework.’” ■

“I’ve had an interest in engineering all my life. I like building things and understanding the mechanics.”

—ISAAC HAYES

WRITTEN BY VINCENT HYMAN

PHOTOS BY JOSH KOHANEK

Collaborating for Results

CSE FACULTY COMBINE DISCIPLINES
FOR RESEARCH RESULTS IN THE
BIOTECHNOLOGY INSTITUTE

The lab-coated scientist toiling alone in the dark may sell in Hollywood, but it's a far cry from reality. Research today is a collaborative, cross-discipline effort. And part of the job of the University of Minnesota's BioTechnology Institute (BTI), jointly administered by the College of Science and Engineering and the College of Biological Sciences, is to actively foster collaboration, says Michael Sadowsky, director of the BioTechnology Institute.

"The BioTechnology Institute was started 29 years ago by the deans of the two colleges, who saw early on the need for collaboration between biologists and engineers. Today, if you do not collaborate, you will

rapidly fall behind your colleagues. There's no question of that," Sadowsky said.

BTI has grown from a few faculty members to nearly 30, representing 17 departments in seven colleges. Biotechnology—the application of biological systems that are either engineered or used in some natural way to benefit society—relies on collaborative efforts, according to Sadowsky.

Faculty of the BioTechnology Institute work in the areas of mechanical engineering, civil engineering, chemical engineering, chemistry, geology, soil, water, climate, agriculture, and microbiology. "We really represent a mix of microbiology and engineering, and it's the microbiology itself that has spread across these broad disciplines and departmental boundaries. All of us use microbes—or microbes and plants together—to achieve some type of goal, whether it's to clean up the environment, produce a novel compound, or aid in some medical area," he said.

BTI fosters hundreds of collaborations. It also reaches out to industry, introducing faculty and potential industrial partners to each other through semi-annual meet-ups. These help graduate students find work in local industries such as Cargill



Civil engineering professors Paige Novak and Tim LaPara are conducting collaborative research on how chemical spills, toxins, and other disruptions affect anaerobic microbial communities.

and 3M and help faculty entrepreneurs find partners for product development.

The College of Science and Engineering BTI faculty members profiled here show how the BTI encourages faculty to participate in interdisciplinary collaborative studies that yield exciting translational results for use by industry and public agencies.

Does antibacterial soap threaten wastewater treatment?

Paige Novak, professor of civil engineering, specializes in research on the biological transformation of hazardous substances, and has more recently been studying the ways that human-introduced contaminants disrupt microbial communities.

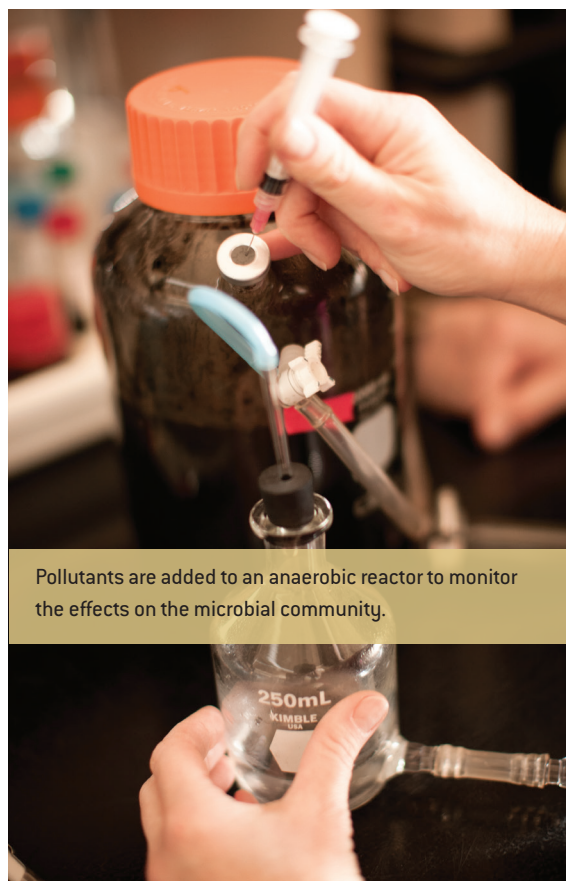
Novak has been collaborating with Timothy LaPara, professor of civil engineering and fellow BTI member, on how chemical spills, toxins, and other disruptions affect anaerobic microbial communities. These communities are critical in certain wastewater treatment facilities.

“If we understand the effect of these perturbations on anaerobic communities, we can recover them faster if there’s a problem,” explains Novak.

All wastewater treatment produces a solid material called sludge, made up of solids from the wastewater itself and the bacteria that are used to treat the wastewater. This sludge can be further treated through digestion by various bacterial communities, leaving behind a useful product called biosolids, while generating methane gas. Some treatment facilities capture this methane and use it to generate heat for the treatment system. These methane-generating microbes are essential to sludge treatment, and their output of methane is one indicator that they are doing their job.

Common personal use products that find their way into wastewater can disrupt critical microbial communities. For example, more than 100 metric tons of triclosan, widely used in antibacterial soaps, are flushed into wastewater plants annually. “The use of triclosan keeps increasing,” said Novak. “Besides soap, we are putting it in toys and clothes. Triclosan tends to stick to solids. It also doesn’t degrade readily under anaerobic conditions. Because it doesn’t degrade, it can accumulate in wastewater digesters.”

The EPA has found a range of concentrations of triclosan in wastewater treatment facilities. So Novak and LaPara examined the impact of triclosan within that range and at four times the maximum found concentration—an amount that might occur in a spill or in a region where the product is more widely used. “At four times the current maximum, we found that you get a significant drop in the function of these microbial communities. The microbes are not digesting at the rate we want and are pro-



Pollutants are added to an anaerobic reactor to monitor the effects on the microbial community.

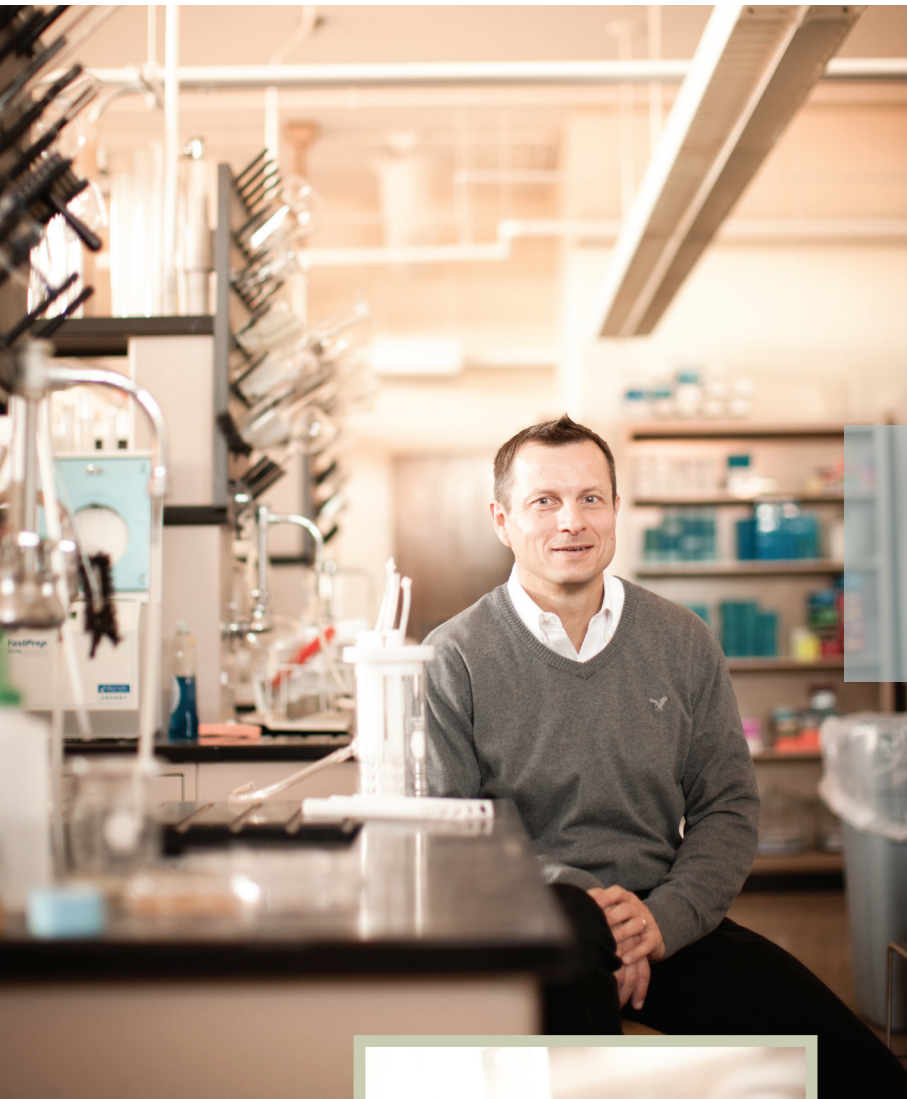
ducing less methane,” she said. “High concentrations of triclosan are bad for anaerobic digesters.”

Moreover, Novak and LaPara found that even normal concentrations of triclosan—those discovered by the EPA—result in a huge variation in methane production. “Some microbial communities do very poorly, and some do fine. We are not sure why yet, but we think this may indicate that at the high end of normal concentrations, the digesters are at a tipping point. Some digester communities begin to fail at the higher end of currently observed levels. There may be digesters in wastewater treatment facilities out there that are beginning to fail, that are becoming more variable in their operations, and that are more problematic because of these concentrations,” she said. Novak emphasizes more work is needed to translate these lab findings into what is happening in actual wastewater treatment plants.

In another finding, Novak and LaPara were curious about how anaerobic microbes that were previously unexposed to triclosan would react when triclosan was introduced. “We took material from an organic farm that had never been exposed to triclosan. Upon first exposure, there would be a blip in the methane production and then the organisms would adapt to behave like the microbial communities that have already been exposed to triclosan,” Novak said.

“You learn more by working with other people. I don’t do work on antibiotic resistance—that is Tim’s specialty. Collaboration let us see the picture of these two responses to triclosan—failure in function versus the acquisition of antibiotic resistant genes.”

—PAIGE NOVAK



Ray Hozalski, professor of civil engineering, and Gary Dunny, professor of microbiology in the University's Medical School, are working on ways to manipulate the strength of biofilms. At right, the metal coupons are used for studying biofilm growth on pipe surfaces and its effects on water quality and pipe integrity.



Moreover, they found that these communities developed antibacterial resistance. "Part of their adaptation was the development of antibacterial resistance. We need to look at more microbial communities to understand the results. It may be that some communities become resistant and others collapse," Novak said.

"You learn more by working with other people. I don't do work on antibiotic resistance—that is Tim's specialty. Collaboration let us see the picture of these two responses to triclosan—failure in function versus the acquisition of antibiotic resistant genes," Novak said.

“It's great that we have this shared interest in biofilms and complementary expertise.”

—RAY HOZALSKI

Engineering “Trojan horse” bacteria to weaken tough biofilms

If you've been to the dental hygienist, you have firsthand experience with biofilms. When the hygienist begins scraping your teeth, he or she is removing a biofilm—a tough, living tissue made up of one or more types of microbe. Biofilms have positive uses, such as in water filtration, but they also grow in places we don't want them. Microbes that create troubling biofilms are colonized in water pipes, teeth, lung tissue, heart valves, and implants such as catheters and prosthetic hips.

Ray Hozalski, a professor of civil engineering, who first became familiar with biofilms as a graduate student, is working on their use in water filtration systems. He explains that the films are tough. Current removal methods are either physical—by scraping, for example—or through the use of a disinfectant or antibiotic.

“When biofilms form on surgical implants the recourse is to try to blast them with antibiotics—which have trouble breaking through—or to surgically remove the implant and put in a new one. Finding some other way to remove these would be a major benefit to the medical field and environmental fields. It is better to try to weaken them and then flush them out, because they are difficult to kill,” Hozalski said.

Hozalski has begun working with Gary Dunny, professor of microbiology in the University of Minnesota's Medical School. The two are seeking ways to manipulate the strength of biofilms. Dunny is a specialist in enterococci, intestinal bacteria that

cause a number of infections. For example, enterococci can develop a biofilm-like colony on the surface of heart valves, leading to endocarditis.

Dunny and Hozalski, both members of BTI, met through a biofilm discussion group at the University, which involves people in microbiology, environmental engineering, dentistry, medicine, and other departments. Through the partnership, they are exploring ways to change the mechanical properties of biofilms by manipulating the ecology of the films, which often contain multiple types of microbes.

"Maybe we can develop a Trojan horse—a strain of bacteria that we add to the biofilm environment that could release an enzyme that degrades the biofilm," Hozalski said. He suggests that this enzyme release could be triggered by various means, such as changing the acidity or oxygen level of the environment. The long-range vision is a bacterium engineered to enter the biofilm benignly, and then switched on to modify the biofilm in the desired way. This could be applied to medical and other purposes.

Hozalski and Dunny have a ways to go before they arrive at practical applications. So far, the team has created biofilms of different proportions of enterococcus and staphylococcus. They have been able to weaken some biofilms, but they have not yet determined the causes. "We have a lot more work to do to tease out the cause. But you can imagine that we could isolate the responsible enzyme, figure out its structure, and then synthesize it chemically or biologically and use that to weaken the biofilms," Hozalski said.

Hozalski is pleased the work may benefit both medical practice and environmental engineering, an outcome of the collaborative process. "I'm an engineer. I'm used to working in engineered systems, while Gary is used to medical systems. It's great that we have this shared interest in biofilms and complementary expertise," he said.

Carbon neutral biofuels

With carbon dioxide fueling climate change, the search is on for fuels and processes that reduce carbon emissions. Friedrich Srienc is collaborating on a project to use the carbon dioxide that's produced during ethanol manufacturing. A professor of

chemical engineering and materials science and BTI member, Srienc currently is on loan to the National Science Foundation, where he is Program Director for the Biotechnology, Biochemical, and Biomass Engineering Department.

"We are working with a naturally occurring soil bacterium that can live only on gases. If you offer it carbon dioxide, oxygen, and hydrogen, it can convert them into cells and grow. It's kind of amazing. It represents a new way to trap carbon dioxide," Srienc said.

For example, one use of the bacterium would be in an ethanol plant, where sugar is converted to ethanol using yeast, but about one-third of the sugar is converted to pure carbon dioxide gas and released into the atmosphere. "A medium-sized ethanol plant produces 250,000 tons of pure carbon dioxide a year. One could envision the addition of a reactor that uses the carbon dioxide to produce even more ethanol, while trapping all the carbon dioxide. All



Friedrich Srienc (in foreground) and Michael Tsapatsis, both professors of chemical engineering and materials science, are working on new technology to convert carbon dioxide produced during ethanol manufacturing.

the carbon ends up in the ethanol, with some left over cell material," he said.

Srienc is working with Michael Tsapatsis, a professor in the Department of Chemical Engineering and Materials Science, to explore ways to make this vision a reality. "Tsapatsis has developed amazing membranes that allow one to selectively separate molecules," Srienc said.



Separating the gas-eating bacteria from the ethanol they generate is crucial, because at a certain point, the ethanol begins to kill the bacteria. Membranes developed by Tsapatsis would filter out ethanol or other biofuels while retaining the bacteria and nutrients, allowing them to continue their work. “Basically you’d have a reactor that contains the cells that produce the product. One could envision a loop that is being pumped out of the reactor and recycled back into the reactor, with the membrane in the loop, separating the biofuels,” Srienc said.

Srienc and Tsapatsis began their collaboration as the two discussed their fields and looked for ways to combine their strengths to make something new. There is far to go before the process envisioned could become viable. The bacteria need to be modified to more effectively produce ethanol from carbon dioxide and hydrogen.

“This could be the basis of a completely new technology for converting carbon dioxide and developing processes that emit less carbon dioxide.”

—FRIEDRICH SRIENC

“Currently we have developed a metabolism model that allows us to predict the pathways and how they work. Based on this model, we are implementing genetic modifications to make them behave as we want. At this stage, the model predicts that we will need 10 or 11 modifications. We have already succeeded with two modifications, and we are very optimistic that it will work,” Srienc said. After that, the membrane separation technique can be implemented.

“Long term,” said Srienc, “this could be the basis of a completely new technology for converting carbon dioxide and developing processes that emit less carbon dioxide. There is a huge opportunity to use synthetic biology for developing a new bioeconomy. Currently everything that we do is produced from petrochemical resources. This will change. We are going to have biological and sustainable processes that will be much more environmentally friendly.”

Purifying fracking water with bacteria

Together, BTI researchers Alptekin Aksan, associate professor of mechanical engineering, and Larry Wackett, a professor of biochemistry, molecular biology, and biophysics in the College of Biological Sciences, are developing a cutting-edge process that



harnesses natural bacteria to purify water contaminated by hydrofracking.

Wackett specializes in biodegradation and bioremediation. He explores natural systems that can be employed to clean up waste products. Aksan specializes in biostabilization. He studies methods of preserving proteins, living cells, and tissues through processes such as cooling, drying, and the development of synthetic organic biomaterial devices.

Aksan and Wackett began their collaboration more than two years ago over lunch one day. They discussed possible connections between their different areas of research, which led to the realization that Wackett’s expertise in biodegradation could be combined with Aksan’s in biostabilization.

The water used in hydrofracking is polluted with some 1,500 hydrocarbons. Currently, the only ways to treat this wastewater are to condense and landfill the hazardous waste or to inject the contaminated water deep underground. Wackett says naturally occurring bacteria could be used to chew up the chemicals—the same bacteria that helped clean up the oil spilled in the Deepwater Horizon disaster of 2010.

“Some of the same oily chemicals come up when water is used to release oil and gas in hydrofracking. We want to take advantage of the natural ability of bacteria to eat these compounds by adding an engineering component,” Wackett said.

The problem is that you can’t just dump the bacteria and fouled water together and hope for the best. The bacteria may not survive, they can’t be recaptured, and the water itself dilutes the bacteria so that they can’t efficiently clean up the hydrocarbons.



“We want to take advantage of the natural ability of bacteria to eat these compounds by adding an engineering component.”

—LARRY WACKETT

Larry Wackett, professor of biochemistry, molecular biology, and biophysics, and Alptekin Aksan, associate professor of mechanical engineering, are working on technology that harnesses natural bacteria to purify water contaminated by hydrofracking.

That's where Aksan's part of the collaboration comes in. Aksan has developed a process called bio-encapsulation that captures the tiny oil-munching bacteria within a sponge made of silica, the same material that makes up sand. This sponge is essential to gaining control of the cleaning process.

Degrading the 1,500 types of contaminants that occur in hydrofracking water requires a combination of different types of bacteria. The complex interaction of contaminants and bacteria presents numerous bioengineering problems, but the silica sponge or matrix can act as a controlled filter. The bacteria are trapped within spaces in the sponge that are just large enough for the cells to move around without escaping. They break down the contaminants into safe byproducts. Aksan has already applied the process to clean up herbicide and pesticide contamination using genetically modified *E. coli* bacteria.

Though the project has been successful in the lab, work remains to scale it up for commercial application. The filtering system must be robust, economical, transportable, temperature-tolerant, and tolerant of human error. Wackett envisions other applications of the same process, such as an absorbent material filled with bacteria that could be spread over chemical spill sites.

“Currently, we have to scrape up contaminated soil and put it in a hazardous waste landfill. If this substance could be used to absorb and degrade the pollutants, we could simply spread it on the spill,” he said. “After the material had consumed the toxins, it would break down naturally and become part of the soil, which is our goal.” ■



Above is the flow-through circulation system used to measure degradation rates obtained with the encapsulated organisms. Below are samples of hydraulic fracturing wastewater and the microspheres that contain the encapsulated organisms used to clean up the wastewaters.





Raise your voice this legislative session for a better University

THIS LEGISLATIVE SESSION, the University of Minnesota is requesting state legislators and Gov. Mark Dayton to fund six capital investment projects, including the renovation of John T. Tate Laboratory of Physics (Tate Laboratory) and Higher Education Asset Preservation and Replacement (HEAPR), which includes projects in Lind Hall, Keller Hall, and Mechanical Engineering. Gaining the support of elected officials for these projects will rely heavily on the advocacy efforts of the College of Science and Engineering affiliates, especially alumni.

The iconic 88-year-old Tate Laboratory is in dire need of renovation to preserve its expanding enrollment capacity, modernize classroom and lab space, and retain its classical architecture. Currently, Tate struggles to serve more than 3,500 students each year and research opportunities are limited by the aging building.

The three College of Science and Engineering HEAPR projects aim to provide better learning environments for students, while extending the lives of the buildings. Specifically, the projects include window replacements, exterior envelope improvements, and electrical and HVAC system upgrades.

All of these projects in the University's 2014 bonding request are essential as the demand for STEM (science, technology, engineering, and mathematics) education in Minnesota increases.

A performance metric in the 2013 state omnibus higher education bill mandated that the University increase the number of students graduating with STEM degrees to help meet Minnesota's growing need for a highly skilled workforce. About two-thirds of U of M graduates build lifelong careers in Minnesota.



Built in 1927, the John T. Tate Laboratory of Physics is in need of renovation. Plans call for the building to be fully gutted and replaced with high-tech spaces that provide new opportunities for students and peers to learn and collaborate.

Dayton recommends full funding for Tate Laboratory

The University is requesting \$232.7 million in this year's bonding bill, for the six priority projects. On January 15, Governor Dayton introduced his bonding proposal which provides \$118.7 million for three University of Minnesota construction projects, including full funding (\$56.7 million) for renovations to Tate Laboratory; \$12 million to the research laboratory improvement fund, which includes the St. Paul campus aquatic invasive species and bee laboratories; and \$10 million to renovate and expand the Crookston campus wellness center, to better serve a growing residential student population and help the campus become a more vibrant regional center.

Dayton's recommendation also provides \$40 million of the \$100 million University officials requested for Higher Education Asset Preservation and Replacement (HEAPR), used to maximize and extend the life of facilities that serve students, faculty, and staff system-wide. One in four of the University's major campus buildings are 70 years old or older, according to capital planning officials. The Twin Cities campus alone has nearly 100 buildings that are more than 50 years old. Many of these buildings require renewal in order to prepare students for successful careers in the 21st century. Renovation of the old part of the Mechanical Engineering Building is among the projects in the University's HEAPR request.

The University will continue to work with the governor and legislators this session to fully fund the U's bonding request, including crucial HEAPR projects, which provide renewal funds and help bring buildings up to code for health, safety, and accessibility purposes. The University itself has committed \$66.3 million to complement the \$232.7 million bonding request.

Your voice matters

In 2011, the personal stories of College of Science and Engineering students, alumni, and faculty helped secure \$51.3 million for the Physics and Nanotechnology Building. Through advocacy, you can help the University to improve the education and research experiences for CSE students. Here are some ways:

- Become educated on the projects. Learn more at govrelations.umn.edu/capital-request.
- Take action. Contact your senator and ask him/her to fully support the University's capital request.
- Share your story about how the University has illuminated your life by visiting the Legislative Action Network at legislative-action.umn.edu. ■

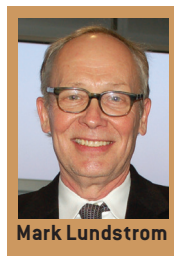
CSE alumni recognized with Outstanding Achievement Awards

THE UNIVERSITY OF MINNESOTA Board of Regents honored four College of Science and Engineering alumni with the Outstanding Achievement Award (OAA) in 2013. The Outstanding Achievement Award is given to University of Minnesota graduates who demonstrate unusual and outstanding achievement and leadership. They are:



Jeffrey Dean (CSci, Economics '90)
Senior Fellow, Google, Inc.

Dean is honored for the design and implementation of the MapReduce framework, which is used by virtually every service at Google and enables a novice programmer to apply data analysis to petabytes of stored data running across thousands of machines. The era of big data has been made possible by the pioneering work of MapReduce. He is also responsible for the design of the first large-scale NoSQL data system—Big Table, in 2006. BigTable ushered in a new paradigm for data storage that better matched the needs of big data by storing data as a set of cells indexed as “row-name, col-name.”



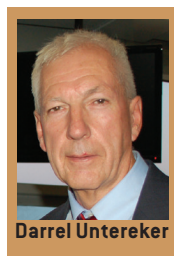
Mark Lundstrom (EE '73, M.S. '74)
Distinguished Professor of Electrical and Computer Engineering, Purdue University

Lundstrom is honored for his groundbreaking effort in scattering models for transistors which provided key insights into nano-scale transistor physics and performance limits. He is known for his pioneering studies of carrier transport in nano-scale transistors, his work on scaling limits of transistors, and his scattering matrix approach to semiclassical carrier transport. In 1997, he co-founded the PUNCH project, an early example of cyberinfrastructure that delivered nanoelectronic simulation services through the worldwide web.



Sun Kwok (Physics M.S. '72, Ph.D. '74)
Dean of Science and Chair Professor in Physics, The University of Hong Kong

Kwok is honored as an outstanding astrophysicist who demonstrated that the dying stars in the immense structures called planetary nebulae form dust and also forge organic compounds that may play a role in the origin of life. He reformed and expanded the teaching of science at the University of Hong Kong, and popularized science through his writings. In addition, he led Canada's and Taiwan's participation in international astronomy and spurred the growth of astronomical research in Asia. Not only has he been a prolific scientist, but an able administrator, and a mentor to junior scientists.



Darrel Untereker (Chem '67)
Vice President, Corporate Research and Technology, and Senior Technical Fellow, Medtronic, Inc.

Untereker is honored for his 37-year career as a scientist and technical leader at Medtronic, Inc. He has played a key role in developing a myriad of technologies critical for medical devices. His problem-solving skills, broad-ranging technical expertise, and ability to work effectively with a wide range of personnel across the entire Medtronic enterprise has been instrumental in making Medtronic one of the world-leading medical device companies, positively impacting the health and welfare of millions of people. He has authored more than 60 publications in several fields and holds more than 40 patents.

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**Join us in celebrating
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INVESTING IN Tomorrow

BY KIM DOCKTER
DIRECTOR OF external relations



Talented students need your generous scholarship support

Our students constantly amaze me. They seem to balance a multitude of responsibilities effortlessly—challenging coursework, internships, as well as compelling project and volunteer work. I am impressed with their desire to make a difference in the world, and the creative ways they “give back.” They are also learning hands-on engineering, leadership, and team-collaboration skills, gaining project management experience, and more. As alumni and supporters of CSE, I know you share my respect for these talented young people, and are interested to learn of a few examples of the more than 60 student organizations in which our students are involved, both in Minnesota and throughout the world.

GOFIRST, a robotics support and alumni organization that mentors FIRST Robotics Competition (FRC) teams, volunteers at regional events, and conducts outreach activities for middle and high school students in Minnesota. Aspiring engineers get hands-on opportunities to apply knowledge acquired in the classroom to a tangible engineering project.

Engineers Without Borders (EWB) partners with disadvantaged communities around the world improving the quality of life for low-income people through engineered projects that prove environmentally and economically sustainable. These students’ concerted efforts have resulted in completing successful water, sanitation, and alternative energy projects in countries such as Guatemala and Uganda.

Innovative Engineers designs novel technology solutions to bring renewable energy to the developing world. Using locally available materials, they provide communities with the technology and knowledge necessary to create and maintain a sustainable energy infrastructure. Presently these students are engaged in an outreach project to bring wind energy and hydro-electric power to rural communities in Nicaragua.

Through these and many other student-led organizations, our students are becoming better scientists and engineers. However, their paths to success are more challenging if they also have to work in order to pay for their tuition. Your generous scholarship support makes it possible for our students to immerse themselves in their coursework and project-based learning.

Increase the impact of your scholarship through the *Fast Start 4 Impact* program where you have a unique opportunity to:

- Create a new, named endowed scholarship supporting students.
- See the impact of your giving right away.
- Continue your legacy with a scholarship or fellowship in your name.

For each new endowment fund of \$50,000 or greater, *Fast Start* will pay four years of annual scholarship awards to students in an amount that is roughly equivalent to what the payout of the fully endowed fund will be at the end of the four-year period. It is designed to build a permanent revenue source for student support and provide funds when they are needed most—right now. The program was launched in September 2012 and will continue through December 2014 or until all incentive funds are committed, whichever is first. Your generosity will give our students a competitive edge and support their drive to invent, innovate, and solve the complex problems of today and for decades to come. ■

Kelso named first 3M Chair in Experiential Learning

FRANK KELSO has been named the inaugural holder of the 3M Chair in Experiential Learning for the College of Science and Engineering. A faculty member of the Department of Mechanical Engineering for nearly 20 years, he is bringing real-life experience to the classroom through the CSE First-Year Experience course, now in its fourth year.

Recognizing that many talented students transfer out of STEM degrees after their first two years, the First-Year Experience course is about retention—helping these students see tangible connections between their coursework and their career goals and personal aspirations.

“The first half of the course helps them adjust to college life and figure out their career aspirations, what classes they might want to take, how to settle in, and what sorts of activities and clubs are available here at the University. The second part of the course involves a hands-on experiential learning project, which last term was to build a sled,” Kelso said.

The project required all 1,000 CSE freshmen, in teams of five, to build an artistic and structurally sound sled from cardboard and PET plastic. Teams used their ingenuity, as well as their math and science skills, to make the cardboard strong enough to support a person. Once completed, teams raced their sleds at Mariucci Arena to see which went the farthest and the straightest.

“That’s where the experiential learning comes in—the fact that they can apply their knowledge, and fail, and learn from their failure, and then modify their solution,” said Kelso. “It’s a cycle, where they try something, they learn from failure, they incorporate the experience into the next try, and then hopefully they get it.”

The 3M Chair and First-Year Experience course is made possible through a generous gift from the 3M Foundation. “Without the 3M funding, I would be up to my eyeballs in grading papers and putting together assignments. It’s basically enabling this whole experiential project and course,” Kelso added.



Frank Kelso, 3M Chair in Experiential Learning, right, works with a CSE freshman student on his sled project.

RICHARD G. ANDERSON

CSE receives \$1 million gift from Valspar

THE COLLEGE OF SCIENCE AND ENGINEERING will receive a gift of \$1 million over five years from Minneapolis-based Valspar Corporation to provide high-tech equipment for the new "Valspar Materials Science and Engineering Lab."

Located in the Gore Annex of Amundson Hall in the Department of Chemical Engineering and Materials Science, the new undergraduate lab will be completed this summer. Once fully equipped in early 2015, the lab will include testing equipment that characterizes the mechanical performance of materials, electron microscopes that image at the nanoscale, and other equipment that can measure magnetic, electrical, and optical properties.

"This gift from Valspar allows us to grow our undergraduate materials science and engineering program and outfit the new lab with state-of-the-art equipment that is second to none," said Frank Bates, head of the Department of Chemical Engineering and Materials Science. "We are thankful for Valspar's support and forward-looking mission to help us build one of the best materials science and engineering programs in the country."

Valspar's shared mission to develop world-class materials science and products, along with proximity of research laboratories were primary factors in the company's decision to award the gift. The gift comes as Valspar completes a major expansion of its Minneapo-



The \$1 million gift from Valspar will be used to provide high-tech equipment for a new materials science and engineering lab at the University of Minnesota.

lis R&D facility this spring. The Valspar Applied Science and Technology Center will enable the current campus to accommodate up to 135 additional researchers and technologists.

"The alliance of Valspar with the University of Minnesota is clearly a strong match with our strategy for science and innovation leadership in the coatings industry," said Dr. Cynthia Arnold, Valspar's Senior Vice President and Chief Technology Officer. "Valspar will benefit from the University's outstanding interdisciplinary program for materials science, a specific coatings program, and proximity to one of our major research laboratories."

CSE leadership event celebrates alumni and students



More than 300 CSE alumni, faculty, and students attended the recent College of Science and Engineering Leadership Event at the TCF Bank Stadium DQ Room. (Right) Jeff Dean (CSci, Economics '90) presented the keynote address, "From the U of M to Google: A Computer

Scientist's Journey." (Left) The 2013 Outstanding Alumni Achievement Award winners—Darrel Untereker, Mark Lundstrom, and Jeff Dean—are recognized by former recipients, Dean Steven Crouch, and University President Eric Kaler. (See story on page 25.)

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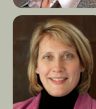
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Retrospect

Celebrating the first students from China

The first Chinese students set the stage for a 100-year partnership with China that has led to numerous research and business opportunities.

In 1914, three young men from Shanghai—two brothers, Wen Huen Pan, who majored in engineering, and Wen Ping Pan, who was a chemistry major, and their friend Yih Kum Kwong, who majored in engineering mining—became the first Chinese students to study at the University of Minnesota. In fact, they were among the earliest Chinese students to attend any American university.

Their courage became the building blocks for today's 80 academic and strategic partnerships with universities in China. This has translated into 2,500 students and 500 scholars from China hosted on University of Minnesota's campuses each year.

First Chinese students arrive

In 1913, when Wen Ping Pan graduated from Tsing Hua College in Beijing, China, students were not allowed to go to the United States due to the political turmoil in China at the time. Pan had attended the preparatory school—where all classes were taught by American teachers, which explained why he could speak excellent English—with future plans of attending a higher education institution in the U. S.

One year later, Pan finally came to the United States. Traveling first by steamship to San Francisco, he boarded a train and rode for 2,000 miles to Minneapolis. He enrolled in the University's School of

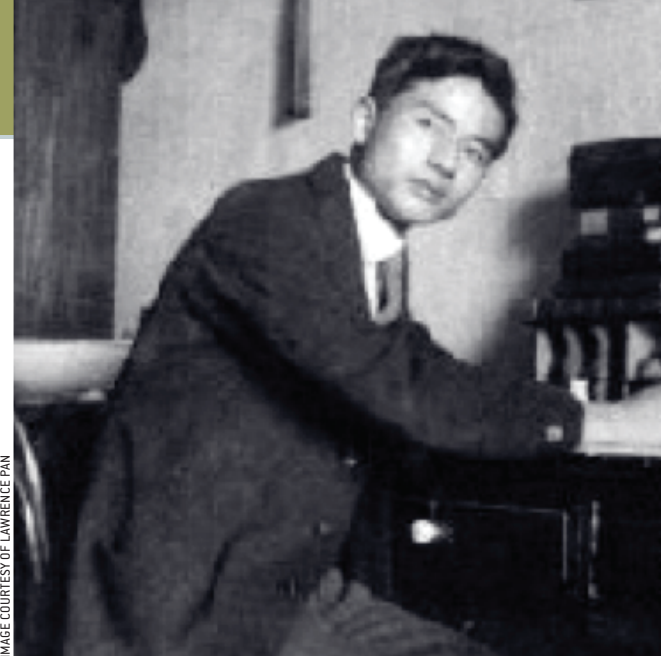


IMAGE COURTESY OF LAWRENCE PAN

Chemistry, which had been recommended by his American chemistry teacher at Tsing Hua. He had officially become the first Chinese student at the U.

Shortly thereafter, Pan contacted his older brother, Wen Huen Pan, who was a student at the University of Michigan, and his friend, Yih Kum Kwong, who was at the University of Chicago. He convinced both of them to join him at the University of Minnesota where they both planned to study engineering.

During their University years, all three students were actively involved in various clubs and sports teams. Wen Ping Pan was one of the founding members of the Chinese Student Club and served as its first president. He was also an outstanding athlete and played on the University's soccer team, along with his brother and Kwong. The sophisticated skills of all three Chinese students led to the University of Minnesota's championship in 1914.

Pan earned his B.S. degree in chemistry in 1918, and accepted a position as an engineer's assistant for the summer at Oliver Mining Company in Chisholm, Minn. He returned to the University and earned a M.A. degree in 1919 in metallurgical engineering as one of the first graduate students from the School of Mines.

After graduation, he worked in a gold mine in South Dakota for field experience before accepting a full-time position with the Oliver Mining Division in Hibbing, Minn., where he worked for 40 years, eventually becoming assistant chief mining engineer. When Pan retired in 1959, the *Chisholm Tribune Press* published an article about his life. It read:

"To come to America was his great dream, and when the opportunity presented itself, he hastened to the portals of the University of Minnesota. He was the first Chinese student at this noted institution and the challenges were great...Mr. Pan loved the American way of life...He believed in the land that he had chosen for his home, and he lived each day as it if were a precious jasmine blossom."

Wen Ping Pan

In 1914, Wen Ping Pan became the first Chinese student at the University of Minnesota. After earning his B.S. degree in Chemistry in 1918, he worked as an engineer's assistant for the Oliver Mining Company in northern Minnesota for the summer. He returned to the University for a master's degree that fall. In 1919, he graduated with an M.A. degree in metallurgical engineering as one of the first graduate students of the School of Mines and served as the President of his class.

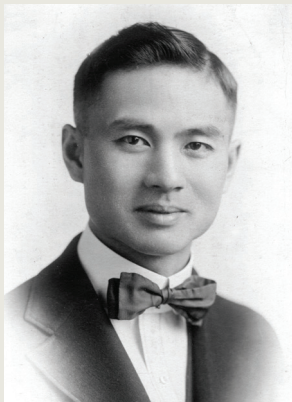


IMAGE COURTESY OF LAWRENCE PAN

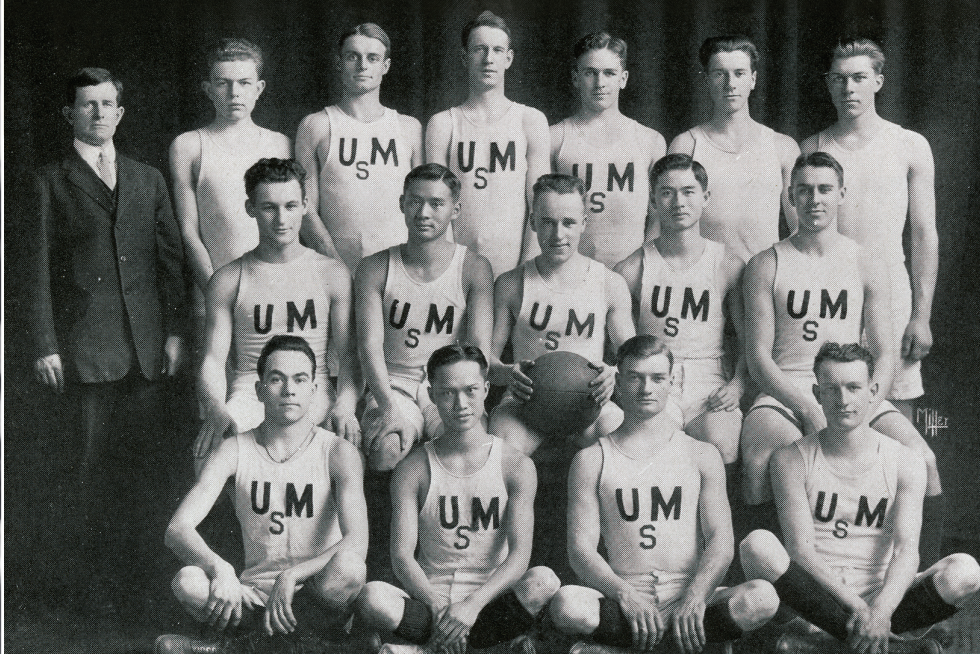


IMAGE COURTESY OF UNIVERSITY OF MINNESOTA ARCHIVES

THEN

(Far left) Wen Ping Pan studies at his desk in 1918. (Left) The University of Minnesota won the 1914 soccer championship thanks to the skilled talents of Wen Huen Pan (second row, fourth from left), his brother Wen Ping Pan (second row, second from left), and their friend, Yih Kum Kwong (bottom row, second from left).

Building bridges for the next century

The University of Minnesota boasts one of the nation's longest and deepest relationships between a research university and China. It was one of the first universities to resume academic exchanges with China in 1979, once U.S.-China relations were re-opened. Today, more than 5,000 alumni live in greater China, and more than 10,000 students from China have earned University of Minnesota degrees over the years.

As part of a year-long celebration honoring those first Chinese students and the wealth of resulting connections, University of Minnesota President Eric Kaler and several University faculty traveled to China, Hong Kong, and Taiwan for 11 days this past summer to solidify additional research and student and scholarship exchange opportunities.

Nine agreements were signed with some of China's most prestigious institutions of higher education and research—including an agreement with Hong Kong University of Science and Technology (HKUST). Kaler also visited Hong Kong's Science and Technology Park to share ideas about innovation and to learn about tech transfer possibilities for University discoveries. Many of the agreements center on working collaboratively to solve the world's most pressing problems.

One significant relationship was formalized with China's prestigious Chinese Academy of Sciences (CAS), which focuses on a two-year-long series of joint workshops between University of Minnesota scholars and scientists to seek solutions to air quality in China.

Leading the effort is David Pui, a mechanical engineering professor in the College of Science and Engineering, and a world-renowned expert on air pollutant particles and the standard known as PM 2.5.

Of all 5,537 international students enrolled at the University during Fall 2012, the College of Science and Engineering enrolled the highest percentage of any college at the University with 1,959 students—813 undergraduate, 1,086 graduate, and 60 non-degree. The majority of those students were from China. More than 200 University students take advantage of 15 study abroad programs in China annually.

Currently, about one in every three students gains an international experience. Kaler would like to see that metric rise to 50 percent.

"Whether it's study abroad in China or another country, we must prepare our Minnesota-born students for a world shaped in important ways by other nations," said Kaler. "On our campuses across the state, we must prepare them for global competency."

■ BY SILVA YOUNG

NOW

The University of Minnesota's reach is wide and deep in Beijing, China. More than 200 alumni met with President Eric Kaler at a University of Minnesota Beijing alumni chapter gathering last July.

LEARN MORE about the history of the U of M and China, find upcoming events, read alumni stories, and more at china100.umn.edu.



UNIVERSITY OF MINNESOTA BEIJING OFFICE PHOTO

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Bright minds. Bright lights. CSE students' technical and creative minds illuminated campus with a Winter Light Show that featured more than 100,000 LED lights synchronized to student-composed music. The magical outdoor experience is just one example of how science and engineering illuminates everyone.

View the show at z.umn.edu/lightshow2013



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